

BOOK REVIEWS:

NEW VOLUMES ON THE “MINOR” ARACHNID ORDERS

The Biology of Camel-Spiders (Arachnida, Solifugae). **Fred Punzo**. 1998. Kluwer Academic Publishers, Norwell, Massachusetts. 301 pp. ISBN 0-7923-8155-6. US\$135.00 (hard cover).

Whip Spiders (Chelicerata: Amblypygi). Their Biology, Morphology and Systematics. **Peter Weygoldt**. 2000. Apollo Books, Stenstrup, Denmark. 163 pp. ISBN 87-88757-6-3 US\$43.00 (DKK 320.00) (hard cover).

Hormiga (2000) recently attributed the dwindling number of publications on the “minor” arachnid orders (in decreasing number of described species—Opiliones, Pseudoscorpiones, Scorpiones, Solifugae, Schizomida, Amblypygi, Uropygi, Palpigradi, Ricinulei)—to two factors. First, these orders are less diverse, collectively comprising only 12.5% of arachnid species, compared with the megadiverse Acari and Araneae, containing some 87.5% (M.S. Harvey unpubl. data). Second, there has been an alarming decline in specialists on these taxa, despite the fragmentary knowledge about most aspects of their biology. At a time when major synthetic publications on the biology of the minor orders are as scarce as the specialists working on them, it is gratifying to report on new volumes that will hopefully restore interest and perhaps stimulate the development of new expertise in some of these intriguing groups.

As noted by Hormiga (2000), Tome VI of Grassé's (1949) *Traité de Zoologie* remains the standard text for the anatomy and biology of most of the minor orders, only two of which have been dealt with in more recent volumes: Pseudoscorpiones (Weygoldt 1969); Scorpiones (Polis 1990). Until recently, pseudoscorpions remained the most “accessible” of the minor orders, for which both a comprehensive synthesis of the biology (Weygoldt 1969) and an up-to-date, fully referenced taxonomic catalogue (Harvey 1990) were available.

Probably due to their medical importance, scorpions have enjoyed disproportionate attention, given that they represent only the third most speciose of the minor orders. A resurgence in studies on scorpions has occurred in the decade since publication of the volume by Polis (1990), culminating in the recent publication of another two volumes, presenting current research in scorpion biology (Brownell & Polis 2000) and cataloguing the taxonomic diversity of the order (Fet et al. 2000). A third volume, dealing with all aspects of scorpion biology, from taxonomy, through ecology to neurophysiology, has just been published (Fet & Selden 2001).

It was hoped that the publication of three volumes on Chelicerata in the series on *Microscopic Anatomy of Invertebrates* (Harrison & Foelix 1999) would provide an update of the information provided in Grassé's (1949) Tome VI for the remaining minor orders. Unfortunately, these volumes dealt only with the Acari, Araneae and Scorpiones, while omitting eight of the minor orders altogether (Hormiga 2000). However, two new volumes, which are the subject of this review, should redress this void for the Solifugae and Amblypygi, two of the smaller and more enigmatic orders for which no synthetic treatments were previously available.

The first of these volumes, *The Biology of Camel-Spiders*, has already received a thorough review by Hormiga (2000); what follows shall serve merely to supplement the latter. In

accordance with the previous reviewer, I am commending the author for filling a notorious gap in the arachnological literature by summarizing available knowledge on Solifugae into a single, clearly written volume. Regrettably, poor production by the publishers, coupled with various inconsistencies, errors and omissions in the content, detract from otherwise fascinating subject matter.

Hormiga (2000) has already lamented the poor production of this volume, which is peppered with typographical errors, misaligned text, oddly positioned blank spaces, scientific binomens not set in different font style, etc. Treatment of the illustrations is particularly appalling. Some are unnecessarily large (p. 43) while others are poorly reproduced from adequate originals (p. 37). Still others are awful regardless of size or reproduction (p. 181). Several are not centered on the page (p. 22) or leave large blank spaces between the illustration and the text (pp. 15, 220). In many cases, the text of the illustrations is too large (p. 52).

Further criticisms concern aspects of the content. Eight chapters deal in somewhat haphazard fashion with the following topics: introduction to Solifugae, including mythology and folklore (10 pp.); functional anatomy and physiology (33 pp.); neurobiology (25 pp.); life history (35 pp.); ecology (43 pp.); behavior (45 pp.); phylogeny, biogeography and taxonomy, including identification keys (44 pp.); field and laboratory techniques (13 pp.). The apparent absence of a logical structure both among and within the chapters inevitably leads to repetition, e.g., discussions of life history in the introduction (p. 8) and of behavior in the chapter on life history (p. 72). Some sections of Chapters 2, 3 and Chapters 4 and 6 would have benefited from a merger.

Valuable, if somewhat disproportionate coverage is devoted to the sections on natural history, habitat preference, diet composition, dispersion patterns, mating and hunting behavior, burrowing biology and diel/seasonal activity patterns (Chapters 4–6), many of which draw on data from the author's own studies. The final chapter provides important information on collecting and rearing solifuges, again drawn from the author's experience. Solifuges are notoriously difficult to maintain alive, let alone rear under captive conditions and the author is the only person on record to

have successfully reared a species of solifuge through an entire generation (Punzo 1998).

Unfortunately, the sections presenting material outside of the author's expertise—anatomy, physiology and neurobiology (Chapters 2, 3) and phylogeny, taxonomy and biogeography (Chapter 7)—provide an unfavorable contrast with the sections on ecological and life history aspects, both in breadth of coverage and in accuracy of content. As previously noted by Hormiga (2000), the anatomical chapters are conspicuous for the paucity and poor quality of illustrations, including the complete absence of photographs (only 15 photographs appear in the entire book, all in Chapters 5, 6), while the chapter on systematics contains several inconsistencies. Most notable is the presentation of Van der Hammen's (1989) non-cladistic classification of the Chelicerata in Table 7-1 (p. 200), rather than the better justified system of Shultz (1990)—derived from a cladistic analysis of morphological data and recently supported by molecular data (Wheeler & Hayashi 1998)—which receives only secondary mention in the text (p. 202). The incomplete treatment of the chelicerate fossil record, with its implications for phylogeny have similarly been noted by Hormiga (2000). According to Fig. 7-1 (p. 198), Araneae are dated from the Carboniferous, despite Devonian spider fossils (Selden et al. 1991), while Solifugae are dated from the Tertiary, although the morphology of a Carboniferous solifuge is discussed a few pages later (pp. 211–214). To these errors and omissions can be added the inconsistent use of terminology, e.g., the old ordinal names Araneida, Scorpionida and Solpugida. On the positive side, this chapter provides a useful synthesis of identification keys, adapted from multiple sources, for the solifuge families of the world, as well as regional keys to the families and genera of North America (including Mexico), Israel and South Africa, and to the South American genera of Ammotrechidae. The book concludes with an extensive reference list (34 pp.)—more than 500 entries on all aspects of solifuge biology (33 by the author, though admittedly only 16 of these deal with solifuges)—itself a valuable introduction to the literature on the order. Indeed, the synthesis of such disparate information on solifuges from a large variety of scattered sources is certainly the most laudable aspect of a vol-

ume that will remain a landmark in the arachnological literature, despite its many shortcomings.

Whip Spiders, the second volume under consideration in this review, follows the tradition of Weygoldt (1969) in presenting another immaculately illustrated compendium on a remarkable order of arachnids. Both thorough content and impeccable presentation make for an unfair comparison with *The Biology of Camel-Spiders*. The publishers are similarly commended for the professional production of this volume.

The book is organized into nine chapters, dealing with the following topics: introduction to the Amblypygi (1 p.); historical background to studies on Amblypygi (2 pp.); external morphology (8 pp.); genera of Amblypygi, including identification key (16 pp.); anatomy and general biology, including behavior (87 pp.); distribution and ecology (9 pp.); endangered species (1 p.); systematics (7 pp.); field and laboratory techniques (2 pp.). These chapters are followed by a bibliography of selected references (7 pp.), no fewer than 33 by the author, but the reader is referred to a more extensive bibliography on the website of the International Society of Arachnology.

As with any such volume, there will always be differences of opinion as to how the subject matter could have been organized. For example, perhaps the large chapter on anatomy and general biology (Chapter 5) could have been split into smaller chapters and some of the smaller, but related chapters (e.g., Chapters 1, 2, Chapters 4 and 8, Chapters 6, 7) merged into larger, more inclusive units. Similarly, some subsections of particular chapters (e.g., the three lines on fighting and territoriality, p. 70) are arguably too short to warrant separate treatment and might have been better combined with others. But these are only minor criticisms of an excellent book overall.

As with his previous book on pseudoscorpions, the author demonstrates proficiency in all aspects of the biology of his subjects—from morphology, through ecology and distribution, to systematics—thereby rendering futile an attempt to find fault with the content. Aside from a distinct absence of errors and an unbiased treatment of conflicting opinions (e.g., the alternative hypotheses of chelicerate phylogeny presented in Chapter 8), the most obvious drawback of this volume (subject mat-

ter notwithstanding) are the many exceptional illustrations that accompany each discussion as supporting evidence. Just as the sections on external morphology and anatomy are liberally illustrated with aesthetically appealing line drawings and clear electron micrographs, so the sections on behavior are illustrated with neat photographic sequences documenting ritualistic postures assumed in encounters between members of the same or opposite sex. Similarly, the sections on distribution, ecology and systematics are supported by maps, habitat photographs and cladograms, respectively.

The author is further commended for presenting the subject matter in a manner that is accessible and informative to both general and specialist readers alike. For example, by drawing on his extensive experience in the comparative morphology and systematics of Chelicerata, the author presents a detailed scientific synthesis and commentary of the characters relevant for delimitation and diagnosis of Amblypygi, as well as the phylogenetic relationships among them and their chelicerate relatives (Chapters 3, 4 & 8). However, the chapter on amblypygid genera should also be very useful to the general reader, for it includes not only a synopsis of each genus, accompanied by photographs of exemplar species, but a straightforward identification key. The sections on anatomy, behavior, distribution and ecology are equally comprehensive and bear testament to the author's many published scientific contributions. But the hard science is rendered accessible to the general reader by the regular inclusion of topics with broader interest, e.g., why are there so few species of Amblypygi, why is the courtship dance so prolonged and why do amblypygid females mate more than once.

Of all the topics covered, it is without doubt the author's meticulous studies on the complex mating behavior and related aspects of the reproductive biology of whip spiders (summarized in Chapter 5) that are most inspiring. During the past 30 years, the author has personally collected, transported and reared more than 20 species of Amblypygi for these studies, some of which are still maintained in laboratory colonies to this day. The difficulty in collecting many of these elusive animals in the wild, not to mention the patience required to maintain them and observe their nocturnal activities, whether in the field

or laboratory, demonstrate an uncommon dedication. *Whip Spiders* is yet another example of that dedication, and will certainly remain the standard text on Amblypygi for years to come, just as Weygoldt (1969) has remained the standard text on pseudoscorpions. I highly recommend this book as an essential addition to the libraries of all arachnologists.

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